

ROCKS and MINERALS

Vol. 3

SEPTEMBER, 1928

No. 3



Courtesy of Gordon & Robinson

Stark's Knob. The only volcano known in New York State

SPECIAL ARTICLES

\$5,000 REWARD. By Dr. Eles

THE NEW MINERALS OF KATANGA. By Edward Cahen

SOME NOTES ON THE BUTTE, MONTANA, DISTRICT. By R. F. H. Harter

STARK'S KNOB. By C. A. Hartnagel

THE MAGAZINE FOR COLLECTORS

THE BULLETIN BOARD

A CHANCE TO DISTINGUISH YOURSELF!

Attention of the officers and members of the Rocks and Minerals Association is directed to the suggestion of Mr. Riffle in "The Sluice Box" of this issue regarding the formulation of a code which would provide descriptive symbols for mineral specimens as an aid and convenience to collectors and dealers in exchanging or cataloging minerals. Mr. Riffle has induced The Gem Shop of Wolf Creek, Mont., which has expressed great interest in this system of description in cataloging, to offer a nice zircon gem for the best suggestion for either the greater part or the whole code if some one individual works out a complete code that is accepted.

In this connection we wish to offer our congratulations and thanks to Mr. Riffle for this very unique and really valuable suggestion. ROCKS AND MINERALS is very glad to receive constructive ideas from its readers and will always give them a prominent place in the pages of the magazine if considered worthy.

MICROSCOPISTS, ATTENTION!

ROCKS AND MINERALS would be very much interested in knowing just how many of its subscribers are making microscopic collections of mineral specimens. We have been contemplating the printing of a series of articles upon microscopic specimens if we can secure just exactly what we want. We should wish to present the subject in so interesting and informative a manner that those who have heretofore neglected this fascinating side of mineralogy might be induced to give it the attention it really deserves. The smaller the crystal the more likely it is to be a true type and under the microscope will arouse real pleasure and enthusiasm when its beauties are fully disclosed in its greatly enlarged

appearance. While the publication of such a series of articles will not depend upon the number of collectors specially interested in microscopic specimens we will appreciate having a postal card from those of our subscribers who are gathering together collections of this character.

IN AN EARLY ISSUE

The Tin Fields of Northern Nigeria, West Africa: By Aubrey E. Horn, Mining Engineer. This is a most interesting and instructive article on the geology of the fields, methods of prospecting and mining the ore, etc., and will be much appreciated by those of our readers who are mining engineers, mine officials, prospectors, or those otherwise interested in mining.

Where and How to Find Minerals: By Morrell G. Biernbaum, Honorary President of the Rocks and Minerals Association. Our readers will be delighted to hear that Mr. Biernbaum has written another article for ROCKS AND MINERALS which we believe to be his best so far. It is not necessary to say it is an interesting article, as the title alone suggests this.

The Romance of Rocks and Minerals: By Dr. R. F. H. Harter. Many of the great countries of the world owe their wealth and prosperity to the mineral deposits within their borders. The Western United States, Mexico, Alaska, South Africa and Australia are only a few instances where the discovery of valuable minerals influenced their growth and development. We are sure our readers will enjoy Dr. Harter's very interesting article, as it brings to our minds the important position played in the world's progress by minerals.

WANTED: Correspondents in all parts of the world who will be kind enough to send us notes and news items on minerals, etc., that they

think may be interesting to the subscribers of "Rocks and Minerals." Such as are available we shall be very glad to print in the magazine.



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ROCKS AND MINERALS

The Magazine for Collectors

Published
Quarterly

Peter Zodac
Editor and Publisher

The Official Journal of The Rocks and Minerals Association

Vol. 3

SEPTEMBER, 1928

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Entered as second-class matter September 13, 1926, at the Post Office at Peekskill, N. Y., under the Act of March 3, 1879.

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Subscription price is \$1 per year in U. S. and Possessions; foreign \$1.25. Sample copies and back numbers, 35 cents per copy. No responsibility is assumed for subscriptions paid to agents, and it is best to remit directly to the Publisher.

Issued on the 1st day of March, June, September, and December. Forms close on the 20th of January, April, July, and October.

Changes of address should be sent in at least two weeks before the date of the next issue of ROCKS AND MINERALS, in order to be effective for that number.

ROCKS AND MINERALS

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TO NEW SUBSCRIBERS

A limited supply of back numbers of **ROCKS and MINERALS** are still available, and we would urge our subscribers to complete their files now before the magazines become exhausted.

September and December, 1926, 30c each; March, June, September and December, 1927, 30c each; March and June, 1928, 35c each—the 8 for \$2.25.

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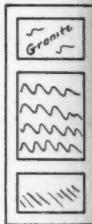
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P.S.—Saw your Ad in **ROCKS AND MINERALS**.

\$5,000 REWARD

For the Location of a Deposit of Quartzite, Calcite, or Dolomite Showing the Reactions Outlined Below.

By DR. ELES, *Chemist*
The de Clair Laboratories,
Los Angeles, Calif.

Considerable interest is being shown at the office of The de Clair Laboratories, of Los Angeles, Calif., by a window display, in which is shown a very excellent collection of Western minerals, ranging in size from one inch to large, massive museum specimens. These are not for sale, but simply an exhibit to call attention to a large sign on which

there is offered a reward of \$5,000 for the location of an ordinary Dolomitic Limestone deposit which is known to occur somewhere in California, Arizona, New Mexico, or Nevada. It is supposed to be an outcrop of Pre-Cambrian formation. Possibly a similar deposit may be found in other states or countries.

Dr. Eles, of The de Clair Laboratories, in his research work, made the discovery that a certain specimen of Dolomite was extremely sensitive to static electricity. It is a well-known fact that Selenite is a conductor of electricity in proportion to its exposure to light. In absolute darkness, Selenite is not sensitive to electricity but the flame of a match or candle or the glow of an electric light (and even daylight) will make it so sensitive that if used as a switch it will ring a bell or give any other electric signal that is necessary. Selenite becomes a conductor, therefore, by means of light vibrations. But the Dolomitic Limestone referred to in this article is thousands of times more sensitive to static electricity than SELENITE! The Limestone does not become a conductor of electricity but it is so sensitive to static electricity that it will respond to such influence, even through two inches of solid porcelain or if insulated by one inch of lead, one inch of water or one inch of iron from freezing temperature up to 1,000 degrees Fahrenheit. On the other hand a magnet does not affect it, neither does a direct current from a motor. Nor has a battery current, either storage or primary, any effect on it. Radium and X-rays likewise have no effect on it.

Dr. Eles sent some of this Limestone to an associate in Europe who has developed further reactions and discoveries, which are valuable enough to warrant the offer of \$5,000 for the location of such a deposit. This means, of course, that upon location or the discovery of



THE POSTED REWARD

such a mineral deposit, parties interested would naturally buy the deposit. About two pounds of this mineral has been obtained by The de Clair Laboratories and sold abroad to interested people at \$84 a pound making this ordinary looking mineral far more valuable than the richest of gold ores.

In appearance the Dolomitic Limestone is granular, of reasonably fine grains, slightly coherent. It has perfect cleavage; fracture subconchoidal; it is brittle, with a hardness of 3.5. It has a vitreous or glossy luster; it varies in color from white and greenish white to reddish-brown; and semi-transparent.

The mineral is composed of Carbonate of Lime and Magnesia in various proportions. One sample analyzed by The de Clair Laboratories carried traces of Carbonates of Iron and Manganese.

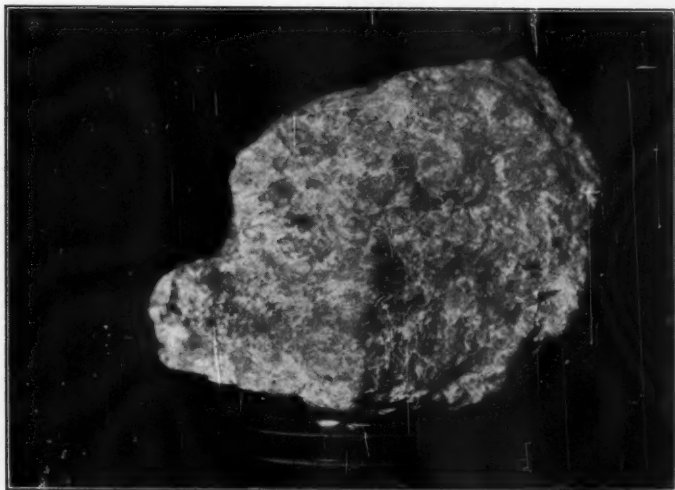
Tested with the spectroscope, under an electric spark, produced by 80,000 volts, the Limestone gave a number of very beautiful absorption bands, covering all of the colors of the rainbow, together with some very brilliant light yellow, green, and blue lines. The whole spectrum with its brilliant colored bands is the most beautiful thing that can be seen through the spectroscope. At 160,000

volts it resolved into Frondhoffer's lines.

As we know, the Frondhoffer's lines of the spectrum are produced by the Electrons escaping from the Atoms. In fact all chemical action is produced by free Electrons. There must be some very strange dynamic force combined in this mineral which is so sensitive to static electricity that once again we may change our new knowledge of the actions of Protons and Electrons. The reactions are altogether different to those of Radium, Radium Emanation or Radium Rays.

Tested on the electroscope, the Limestone showed no reaction whatever, yet after exposure to a very slight electric current it would discharge the electroscope almost as rapidly as pure Uraninite. This ability to discharge the electroscope remained in the mineral for a week after an exposure to current, after which it became neutral as far as the electroscope tests were concerned.

There are, of course, a number of other discoveries and reactions made by The de Clair Laboratories and friends that are of a confidential nature and it would not be fair to those interested in the financial end to make these discoveries and reactions known to the public at present.



THE DOLOMITIC LIMESTONE.
This piece, 12 ounces, sold for \$63.00.

The peculiar properties of the Calcium and Magnesium contained in the Dolomitic Limestone have also been found in certain Quartzites.

It is quite possible that this new Dolomitic Limestone will answer the vexed question of scientists as to—What is Magnetism? An electric field creates a magnetic one. The North Pole of the earth, situated at its axis, is quite a distance away from the magnetic pole which attracts the needle of the compass and it is at either extreme pole that the phenomena, known as the Aurora Borealis, takes place.

Dr. Eles believes that the weird lights are caused by static electricity forming its magnetic lines at each pole of the earth. At certain seasons in the atmosphere of the sun there are a number of black spots which are really openings in the photo- and chromosphere of that incandescent globe. Dr. Eles believes that with an opening of this sort, large enough to swallow the earth with ease, there is a lack of Electrons shoot-

ing through space and that when this happens, interference is caused with the static electricity of the North and South Poles, creating Electron disturbances. This makes the beautiful curtains of visible static electricity which wave and move in space with a crackling noise, producing the Aurora Borealis, which the specially fitted yacht, "Carnegie," carrying no iron or steel in its makeup has gone out to investigate.

Dr. Eles passed his discoveries on to a brother chemist in Europe who in turn made some additional discoveries that appear to be of value in the Arts. The reward of \$5,000 is offered anyone who can give definite location where a Quartzite, Calcite, Dolomite, or any other mineral carrying the above reactions can be found. The de Clair Laboratories will analyze—FREE—any mineral sent to its office (with name of locality where found) and is ready to pay the reward upon proof of the discovery of the locality only and not for the property itself.

NOTES ON MINERALS FROM BEDFORD, N. Y.

By EDWARD GILDEN

of the Boy Scout Mineral Club, 1 Bank St., Stamford, Conn.

Most mineral collectors and mineralogists around this vicinity are well acquainted with the Bedford quarry. The writer has collected at this locality the following minerals: green and blue beryls in large crystals but not of gem quality; thin tabular specimens of ilmenite associated with massive manganese garnets and quartz; columbite, fairly well developed crystals more brittle and less iridescent than the specimens obtained at Branchville, Conn.; small scales of autunite on uraninite with zircon (massive) found in the North quarry. The uraninite and zircon are rare. Traces of autunite have also been found on microcline. It has been reported that a few golden beryls have also been discovered. Iron pyrites are found with a ferrugin-

ous coating as small crystals associated with partly disintegrated microcline. Black tourmalines with perfect terminations are plentiful and are found with quartz as a matrix. Rose quartz of a fine deep color, somewhat opalescent, is found abundantly. Likewise black massive quartz that is decidedly opaque, in fact the finest the writer has ever seen. Muscovite has been obtained in the South quarry, thin sections of sheets show very distinct outlines of magnetite. Quartz crystals of peculiar habit in parallel position and with the appearance of formation under pressure are obtained in contact with red microcline and quartz.

I think that anyone in this vicinity who is interested in minerals would benefit greatly by a visit to this quarry.

THE STORY OF IRON

By P. WALTHER

508 Muriel Parkway, Elizabeth, N. J.

When and where the first iron implements have been used is not known but it is very probable that originally it was the meteoric iron, which thousands of years ago furnished the inhabitants of Asia and Africa, the metal from which they manufactured their tools and weapons. That it may have been of meteoric origin is indicated by the names given to iron by the ancient Egyptians, Greeks, and Hittites. The Egyptians called iron—*Ba En Pe*—that is, Metal of Heaven. The Greeks called it *Sideros* which is somewhat similar to the Latin—*Sidus Sideris*, meaning Star. The Hittites (who formerly lived in Europe at about 3,000 B.C. wandered into Asia Minor and Kreta) called the servants of their great Goddess—*Rhea Dactyloi*. The *Dactyloi* were supposed to be living in the earth and at the time of Sophocles they were mentioned as workers of iron in Kreta.

That the early Egyptians were acquainted with iron is proved by the name of one of their first kings who lived about 3800 B.C. His name was *Mybempes*, that is "friend of iron." In the Great Pyramids, in Egypt, Mr. Hill, an Englishman, found between two blocks of stone, a piece of iron which is estimated to be at least 5300 years old. This is now in the British Museum. A bronze statue of a high Egyptian statesman that was cast during the 19th or 20th dynasty, was found to contain an iron rod that was evidently used for strengthening the figure. This would make the statue about 3,000 years old. At the time of the 18th dynasty the Egyptians were not manufacturers of iron on a large scale, however, which is proved by the two words then used for iron. First "*men*" which meant iron, mostly weapons, manufactured in Ethiopia, and second "*tehaset*" which meant locks, door fastenings, plates, etc., made in Persia.

The Sumer people, who lived about 4,000 B.C. in Mesopotamia, and the countries surrounding that region, also knew of iron.

Iron has been known in China for at least 2300 B.C., and at that time the Chinamen had two names for it: "*Tie*" for the ordinary soft iron, and "*Low*" for steel.

The manufacture of iron from the ore has been invented, very probably, by many peoples on earth quite independently from one another. The Negroes of South and Central Africa had this process as did many of the races in Europe and Asia.

For a long time it was thought that the Indians of America knew nothing of iron until the Spaniards came over. But this is not so as the Indians in Mexico knew of this metal long before this. They had a common name for iron and copper "*Wo Te Teputzli*" meaning, ductile metal. Then they discriminated between the two and called the copper "*Michiltic Teputzli*" meaning, red metal (*Teputzli* means metal); the iron they called "*Tliltic Teputzli*" meaning, dark metal.

The Chilean Indians called iron "*Pamilque*." Weapons made from iron were "*Ciuchel*."

The Peruvian Indians of the Inca's time called iron "*Quillay*."

Not until around 900 B.C. did the inhabitants of middle and northern Europe learn the art of working iron. Of course iron objects have been found in graves that go further back than this period, yet they show clearly that they are of oriental origin and were brought perhaps from the Caucasus, as other objects found with them show the same oriental style as finds of the same period in graves in the Caucasus.

That all the great conquerors of olden times as Timur Lenk and Attila had swords "fallen from heaven," as told in old folk lore tales, sounds plausible, for the late Czar of Russia had such a sword, made ages ago, the metal of which was obtained from a meteorite.

Native iron of terrestrial origin has been found in many countries. In most, if not all cases, it is a reduction of iron

pyrites or other iron ores, by reducing agents as coal, etc., or through the action of molten masses as basalt, etc. So in Thuringia, near Mulhausen, in carboniferous slate and at Dito, near Wurzburg, where lumps up to 1 oz. weight are sometimes found. Then, too, in Bohemia lumps formed through a reduction of iron pyrite nodules; on the St. Johns River in Liberia, where native iron covers microscopic crystals of magnetite; in Montgomery County, Virginia; in Burke County, North Carolina. Native iron has also been found in a tree which had been changed into limonite in Smaland, Sweden, and in many basal-

tic rocks in Germany. All of the above finds, however, are overshadowed by the enormous deposits of terrestrial iron in Greenland where masses up to 560 tons have been found.

The longest known deposits of native iron, however, are the blocks of meteoric iron, the total weight of which is estimated at over 200,000 pounds and of which the greatest has been discovered in a valley of the Sierra Madre, in the Cordilleros near Bacubirito, State of Sinaloa, Mexico. It is $4\frac{1}{2}$ yards long, over 2 yards wide, and nearly 2 yards thick, with an estimated weight of 100,000 pounds.

THE SLUICE BOX

By A. RIFFLE

Tourist: "How old do you figure this rock is?"

"Old Bill": "One million and three years."

Tourist: "How can you arrive at such an exact age figure for a rock?"

"Old Bill": "Well, Prof. Smith was out here on some field work in 1925 and he told me at that time that it was a million years old."

Here is a worth-while task for the Rocks and Minerals Association. Why not figure out a standard scale of letters, figures, or symbols that would represent various standard sizes of mineral specimens and to be known as the Rocks and Minerals Association scale. This would be a great convenience to collectors and dealers in cataloging specimens.

A system that would provide symbols for loose crystals, crystals in matrix, and massive minerals together with letters or numbers to indicate size should be easy to work out.

For example, a $\frac{1}{2} \times 1$ inch crystal in a 2×2 matrix could be expressed thus: xm, with a figure for the size of crystal and a letter for the size of the matrix.

Again a code as follows: X-1-0 could represent a loose crystal— 1×1 inch—opaque. As an elaboration on this F could mean fragment; G gemmy; etc.

I believe that the convenience of such a code will become more apparent the more you think it over and I would suggest that the readers of ROCKS AND MINERALS and the officers of the Association take this matter up seriously. The scale should include a wide range of sizes and symbols descriptive of the character and condition of a specimen. Such a code could be published in ROCKS AND MINERALS so that each collector would have it handy as reference.

I was going home with the June number of ROCKS AND MINERALS in my mail when I came across "Old Bill" fishing back of a big rock in the Creek. I tore off the wrapper of the magazine and we looked it over together.

"Well," said "Old Bill," as he unhooked what he calls a "soft nose trout" (sucker) and threw it on the bank, "any collector who wouldn't pay a dollar a year to get that magazine wouldn't jar loose five cents as admission to see Cal Coolidge turn a handspring."

THE NEW MINERALS OF KATANGA

By EDWARD CAHEN, A.R.C.Sc., F.I.C., F.C.S.

(Author of "The Mineralogy of the Rarer Metals")

If the reader will take the trouble to glance at a good map of central and southern Africa, he will find the province of Katanga in the Belgian Congo, just north of Northern Rhodesia and west of Lake Tanganyika; furthermore, if the map is colored geographically it will be noticed that the district of Katanga lies in pretty hilly country anywhere from 1,600 to 4,000 feet in elevation. Another piece of information to be gleaned from a study of the map is that a railroad traverses the district. Chinkolobwe, a name made famous by the discovery of the new minerals, is roughly 120 kilometers northwest of Elisabethville in a direct line. It was here, in the southernmost corner of the Belgian Congo, that one of the most wonderful finds of minerals, new to science, was made in 1915 in a lode of pitchblende. Whether this is due to some freak of Nature or to the marvellous laboratory work of Professor Alfred Schoep of the University of Ghent, who made the determinations of the minerals, I shall

shortly describe, I will leave to the decision of the reader.

This little corner of the Belgian Congo must be a veritable paradise to the mineralogist, for in addition to the secondary uranium minerals with which this article is taken up, the locality is rich in a large variety of other well known minerals of copper, cobalt, tin, gold, and other metals. Precious Malachite of great beauty is about the most noted mineral from this district. At Busanga, cassiterite and rutile are found; not far off from here at Ruwe, gold is found and worked and also a rare vanadium mineral, psittacinite. The cobalt minerals from Luisha comprises the carbonate Sphaero-cobaltite; the sulphide linnaeite; and a rare cobaltous-cobaltic hydroxide, heterogenite, which is found on many of the uranium minerals at Chinkolobwe. Other rare metals are molybdenum in the form of wulfenite and selenium which occurs in the uraninite. Torbernite is found among all or nearly all the altered uranium minerals, its beautiful emerald-green plates being easily recognizable. At Likasi, close by, a new mineral, buttganbachite, is found. It appears to be isomorphous with connellite. Carnotite has been found in a sandstone at Chinkolobwe and has been described by Professor Schoep in the Belgian Bulletin of Geology, who compared it with the well-known deposits in the Paradox Valley of Colorado and Utah.

Having thus briefly referred to the minerals of Katanga, that are of more general interest, we may now pass on to those new minerals which have made this locality famous.

The minerals of this unique deposit are found in lodes in metamorphic rocks of sedimentary origin. They are all secondary minerals distinguished in most cases by a fine yellow or orange color from the dark primary pitchblende, from which they have been derived by alter-



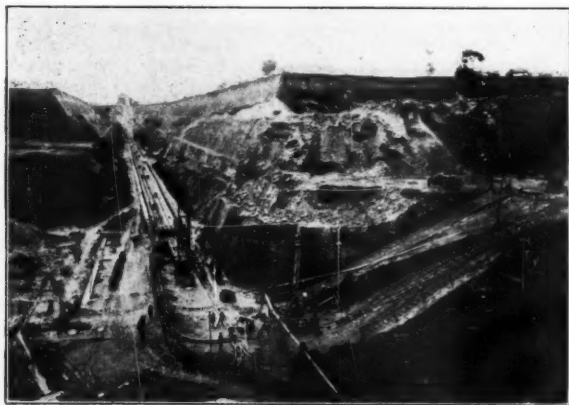
Map of Africa showing the Katanga District in the Belgian Congo. Belgian Congo is one of the world's most marvelous mineral regions. It is the most important producer of radium and cobalt in the world, second as a producer of diamonds, third as a producer of copper, and making great strides in the production of gold and tin.

ation. For the sake of clearness I will give a list of these new minerals and their chemical formulas so far as they have been definitely determined. Then I will give a brief description of the salient features of each one in turn. Space will not permit a detailed account of the methods of chemical analysis by which they have been determined. Needless to say the microscope has been invaluable in the determination of crystalline forms and other peculiarities which distinguish one from another. Not infrequently, only very small quantities of pure material were available for work so that micro-analysis had to be resorted to to discover their constituents.

Janthinite: If we wish to learn something about these new Katanga minerals it is necessary to study them in the order in which I have placed them as in this way their chemical inter-relationship becomes apparent. It is a little unfortunate, however, that the last mineral to be discovered and about which the least is known, has to be taken first. This "very curious mineral," as Professor Schoep calls it, occurs in minute radiating crystals on the Kasolo pitchblende. Seen in this way its great beauty and astonishing color is not evident. But under the microscope a very small quantity of the mineral prepared with Canada Balsam is seen to consist of



Map of the Katanga District, showing copper, tin and other deposits. The copper district is about 200 miles long and about 70 miles wide at its broadest point. Lufira River cuts through this belt at approximately its narrowest width, where it thins down to about 20 miles.



Courtesy Union Minière du Haut Katanga.

The open-pit copper mines at Ruashi, Katanga District. The copper deposits of the Belgian Congo are among the richest known. In 1927 the mines of this famous district produced 88,000 tons of copper. Beautiful specimens of precious Malachite come from these mines.

elongated prisms (Rhombic) of the most lovely shade of violet. One certainly does not associate this color with an uranium mineral. Janthinite gives all the tests for an uranous salt, its solution in HCl, for instance, is green and immediately decolorizes potassium permanganate. Its exact chemical formula has not as yet been determined. It received its name from the Greek word for violet.

Becquerelite: When janthinite is oxidized, the yellow mineral, becquerelite, is formed. Professor Schoep has in his possession, crystals of janthinite of which one end is thus oxidized to becquerelite. Becquerelite occurs on pitchblende with anglesite and also on curitesoddyite as minute crystalline pseudo-hexagonal crusts. It is a hydrated oxide of uranium containing 86.5% UO_3 and about 5% PbO . Its density amounts to 4.95. It was named in honor of Henri Becquerel, who, in 1896, discovered the invisible rays which are emitted by all uranium compounds.

Schoepite: This mineral can only be distinguished chemically from becquerelite by its lesser lead content which is less than 1%. It occurs with becquerelite and is very similar to it in appearance, being pale yellow. It contains

84.99% UO_3 . It was named after Professor Schoep whose name will always be associated with the minerals of Katanga.

Curite: This mineral can at once be distinguished from all other minerals found at Chinkolobwe, by its truly magnificent orange color. It crystallizes in the rhombic system in acicular needles or flattened prisms. It is also found compact and earthy. Curite occurs on torbernite and pitchblende in association with soddyite. It is a hydrated lead uranate and consequently gives reactions for both lead and uranium. It contains 74.22% UO_3 and is named after Pierre Curie.

Fourmarierite: This is another hydrated uranium lead oxide of which as yet but little is known. Even its formula is at present somewhat uncertain. It is reddish-brown in color, crystallizes in the rhombic system, and exhibits dichroism. It was named after the Belgian geologist, Professor Paul Fourmarier.

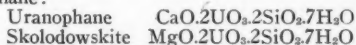
Soddyite: Here we have a hydrated uranium silicate, of a dull yellow color, which is opaque or rarely translucent, micro-crystalline, and usually compact. Its specific gravity is 4.63 and its hard-

ness from 3 to 4. It occurs with curite and pitchblende, sometimes with torbernite. Heated in a bulb tube, soddyite loses water and oxygen, turns black but does not revert to its original yellow color on cooling. It dissolves in acids with deposition of gelatinous silica. The mineral contains 85.3% UO_3 and was named after Professor Frederic Soddy who has done such admirable work in radioactivity.

Kasolite: In this mineral we have a combination of both lead and silica with uranium, the chemical tests bearing out this statement. It contains 49% UO_3 , has a hardness of 4 to 5, and a density of 5.96. Kasolite is ocher-yellow to brownish-yellow and usually found in compact crystalline (monoclinic) aggregates with occasional tufts and radiating groups of prismatic crystals on the surface. It occurs with curite and torbernite on pitchblende, occasionally in veins in talc schists. It is named after Kasolo, a small affluent of the river Tartara between Kambove and Elisabethville.

Sklodowskite: Formerly named chin-kolobwite after the locality where all these uranium minerals occur, it was found to be identical with sklodowskite (named in honor of Madame Curie, nee Sklodowska), and the latter name was retained. Like so many of these Katanga minerals, sklodowskite occurs in

both crystalline and compact forms, the density varying from 3.54 to 3.74 accordingly. It is a pale yellow mineral crystallizing in fibrous microscopic radiating nodules. It is opaque or translucent and possesses a perfect cleavage. The most interesting feature about this mineral is its isomorphism with uranophane:



Dumontite: This is a hydrated uranium phosphate containing 56.49% UO_3 , of an ocher-yellow color, and belongs to the rhombic system as it crystallizes in biaxial elongated prisms. It occurs closely mingled with dewindtite but can readily be distinguished from it under the microscope by its high birefringence. It received its name after Andre Dumont, a Belgian geologist. Dumontite gives the same chemical reactions as do dewindtite and parsonsite.

Dewindtite: This mineral is always found associated with torbernite and a white powdery substance resembling talc (which contains much alumina). It is canary-yellow in color, brilliant and transparent, with a perfect cleavage. Its density is just over 5 and the mineral contains nearly 60% UO_3 . It crystallizes in minute rectangular scales or flattened prisms of the rhombic system. In the oxidizing flame the mineral fuses to a



Courtesy Union Minière du Haut Katanga.

The open-pit copper mines at Kambove, Katanga District. The wood, piled between the tracks, is used as fuel by the engines and steam shovels.

black bead whereas in the reducing flame with soda, beads of lead are formed. It was named in memory of Dr. Jean Dewindt, a student of Ghent University, who was accidentally drowned in Lake Tanganyika, Africa.

Parsonsite: The last of the Katanga minerals discovered up to date was named after Professor A. L. Parsons of the department of mineralogy in the University of Toronto. This mineral occurs with torbernite, which it will be remembered is a hydrated phosphate of uranium and copper. The color of parsonsite is given as chocolate-brown, but the specimen in my possession is much lighter and more closely resembles powdered chocolate. It is earthy in appearance but also occurs compact. It has a greasy luster and the minute crystals belong to either the monoclinic or the triclinic system.

To describe each of these eleven minerals even as shortly as I have done, savors rather of the catalog, but those collectors who are specially interested in the mineralogy of the rarer metals will be able to gain a much clearer conception of the work accomplished by Professor Schoep in separating these minerals from the mass of material he must have had at his command. The descrip-

tions I have given are authoritative as they are taken from the original papers describing them and further aided by examining the actual minerals from the locality and slides, made for the microscope, from these minerals.

I should like to express my thanks to Professor Schoep for sending me the set of papers describing the minerals, accompanied with a collection of the minerals themselves, and for specially preparing for me a slide of janthinite that I might see the beautiful color of this mineral.

My thanks are also due to the Union Minière du Haut Katanga of the Rue de la Chancellerie, Brussels, Belgium, for the loan of the photos illustrating this article. In this connection I might mention that although they have huge works in the heart of Africa where their other products are worked up, it was found more advisable to extract the uranium and radium, from the Katanga minerals, in Belgium. The ore is so rich in uranium that the freight charges are easily borne by the value of the ore itself. The process of extracting radium from such ores is a long and most delicate one, and can be much better conducted in a modern plant where every facility is at hand.

LIST OF THE ELEVEN NEW MINERALS DISCOVERED AT CHINKOLOBWE, KATANGA, BELGIAN CONGO, AFRICA, AND DETERMINED BY PROFESSOR ALFRED SCHOEP OF THE UNIVERSITY OF GHENT, GHENT, BELGIUM.

<i>Name of Mineral</i>	<i>Color</i>	<i>Chemical Formula</i>	
Janthinite	Violet	$\text{UO}_2\cdot 7\text{H}_2\text{O}$	Oxides of Uranium
Becquerelite	Yellow	$\text{UO}_2\cdot 2\text{H}_2\text{O}$	
Schoepite	Yellow	$\text{UO}_2\cdot 2\text{H}_2\text{O}$	
Curite	Orange	$2\text{PbO}\cdot 4\text{UO}_3\cdot 5\text{H}_2\text{O}$	Uranates of Lead
Fourmarierite	Reddish-brown	$2\text{PbO}\cdot 4\text{UO}_3\cdot 5\text{H}_2\text{O}$	
Soddyite	Dull yellow	$12\text{UO}_3\cdot 5\text{SiO}_2\cdot 14\text{H}_2\text{O}$	Uranates and Silicates
Kasolite	Ocher-brown	$3\text{PbO}\cdot 3\text{UO}_3\cdot 3\text{SiO}_2\cdot 4\text{H}_2\text{O}$	
Sklodowskite	Pale yellow	$\text{MgO}\cdot 2\text{UO}_3\cdot 2\text{SiO}_2\cdot 7\text{H}_2\text{O}$	
Dumontite	Ocher-brown	$2\text{PbO}\cdot 3\text{UO}_3\cdot \text{P}_2\text{O}_5\cdot 5\text{H}_2\text{O}$	Phosphates
Dewindtite	Canary-yellow	$3\text{PbO}\cdot 5\text{UO}_3\cdot 2\text{P}_2\text{O}_5\cdot 12\text{H}_2\text{O}$	
Parsonsite	Chocolate-brown	$2\text{PbO}\cdot \text{UO}_3\cdot \text{P}_2\text{O}_5\cdot \text{H}_2\text{O}$	

ON THE ACQUISITION OF SPECIMENS

By ALBERT C. BATES

Newark, N. J.

In so far as my business life would permit, I have for 45 years been actively engaged in collecting specimens of crystallized minerals. By collecting, I mean the visiting of mineral localities affording specimens; by exchanging; and by buying of regular dealers. In the light of this experience, I should be able to give some worth-while notions that may be of use to the younger generation of collectors. Lest I stray too far afield in yielding to my inclination to write about minerals I shall confine myself simply to the subject of acquiring specimens in the three ways named.

Working the localities has many advantages because of the knowledge the nature of the occurrences give one. After seeing the minerals in situ, learning how to dig out specimens even from the dumps, cleaning and trimming them, deciding on the quality worth keeping (the latter to be measured by the averages the locality affords), etc. The taking away of poor material for purposes of exchange is positively bad. Take the good material only and earn a fair name for square dealing in exchanging.

On the whole exchanging is generally unsatisfactory except with regular dealers. With them, if you can arrange an exchange, you will have a wide stock to select from.

The selling of minerals by amateur collectors is by some looked upon as objectionable, probably because in the field of sports an amateur must not profit from his profession. Personally, I see nothing for anyone to criticize in the matter of selling minerals, and I, myself, have been selling many of my duplicates, in a private way, during all the years of my collecting life. Many times have I picked up a fine specimen at localities, specimens much too large for a place in my own collection, and have had the good fortune to dispose of it to museums or dealers for either cash or exchange. But the money as received became a fund from which to buy good specimens as opportunity afforded.

Build up your collection in any honor-

able way opportunity affords. But you should know opportunity when it comes your way. This point can be illustrated very clearly. Perhaps the majority of fine crystallizations are found near the surface of most deposits. Thus the glorious azurites and malachites and cuprites of the Copper Queen mines at Bisbee, Arizona, came from near the surface and for a time the dealers had splendid stocks from the output of these mines. Let us take the offerings of these products as an illustration of what is meant by liberal buying of extra fine specimens. A dollar bought a really fine 2 x 3 or larger specimen of any of the three minerals named. I saw shipment after shipment unpacked, labelled, priced, and exhibited by the leading dealers in New York City. I watched the buying also. The majority of customers were satisfied with one of each mineral and often the cheaper ones. The knowing ones made up suites, showing the variations of type and sizes of the crystals, and it is doubtful if their like will ever again come to light. Soon the mine ceased to show these fine crystallizations, petering out with depth, as is so often the case. If you can afford to do so by all means follow the methods of the wise collectors for besides the satisfaction gained in owning fine specimens, the investment should also be a good one. Within the month of writing this, one of the azurites in the hands of the original buyer, and for which he had paid \$1, was shown at a club meeting and he had several offers of \$5 for it. I have known of many such instances and have never failed to profit by them.

Almost every collection has to meet with a final disposition by its maker or his or her heirs, and the better the collection the better are the chances of a sale with profit.

This is often true of collections in every field of endeavor and you can make the same true of your efforts. Better a good representation of a few species than a poor one of a wide range.

Nothing that is said here is meant to discourage anyone, rather the contrary. Think it over.

SOME NOTES ON THE BUTTE, MONT., DISTRICT

By R. F. H. HARTER, M.Sc., Ph.D., F.I.S.



Map of Montana, showing Butte and other cities.

As one of the foremost mining districts in the world, the Butte district of Montana, is of special interest to mineral collectors and to students of the Earth-Sciences.

As a producer and past producer of wealth it ranks among the leading Western metal producing States.¹ In 1927, Montana produced gold, silver, copper, lead and zinc to the estimated value of \$48,078,000; most of which was represented by the Butte operations. Specifically, the values of metals as estimated for the year 1927 are gold, 55,575 ounces; silver, 11,097,100 ounces; copper, 224,600,000 pounds; lead, 36,500,000 pounds; and zinc, 143,400,000 pounds. Last year was unfavorable in comparison with the year 1926 when metals to the total value of \$59,410,453, were recovered.

Naturally, a district of such economic importance can be of great interest from the applied scientific aspect. Here geologists, mineralogists, petrologists, geochemists, and geophysicists may study and ponder, solve and unsolve, conceive, deduct or adduct theories in any manner to fit the facts or fancy. One thing is sure, however, here Nature found a favorable place to plant a commercial garden of minerals.

The Butte district,² a somewhat wide term, usually meaning anywhere far or

near to the city of Butte, depends upon the prospect being promoted, but geologically, any area in the Boulder batholith.

The country rock is quartz monzonite, commonly called Butte granite; rhyolitic porphyry or Butte porphyry. Practically all of the ores of the district are found in veins or replacement fissures, of these rocks.³

"Gouge" the filling, usually found as seams or streaks parallel with and often between the walls, represents the hydrothermal alteration of the monzonite and the porphyry. This "gouge" or "waste" as it is commonly called, varies greatly in composition and mineralization; sericite, chlorite, fluorite, calcite, dolomite, barite, epidote, and albite are often present. If not barren of metallics, pyrite, chalcocite, chalcopyrite, and very often chalcantite are most likely to be found, usually too weakly disseminated but often with sufficient strength to make the gouge a commercial mineral group or ore, carrying about 3% copper.

It should be noted here that generally the ore lies on either side of the vein walls, or a streak on both sides the foot-wall and hanging-wall; the gouge constituting the filling of the vein. The mineral "gangue" is mostly quartz for gold, silver and copper ores, but varies

greatly with the ores of lead, zinc and manganese. Often the wall rock is also altered to such an extent that it resembles gouge. This makes dangerous mining if the altered wall happens to be the hanging side of the vein, forming a "false-hanging wall" which often breaks down with little warning in all sizes of slabs.

There are in the Butte district five general classes of ore: 1, Gold; 2, Silver; 3, Copper; 4, Zinc and Lead; and 5, Manganese. There is no distinct division of the classes but each class grades into others.

GOLD ORES.

The first mineral wealth of Butte and of the Butte district was produced from shallow placers, which netted mostly heavy dust, and a few nuggets. Mr. William Parks, after whom Park Street, one of the important streets of Butte was named, told the author in 1921, that in the year 1865, near what is now the Pennsylvania Mine on East Broadway, he panned dust that netted about \$100 a pan; not many pans, however, he further stated, produced that much.

Montana gold does not seem to occur in as many forms as the gold in California or Alaska. Nearly all the free gold ores of the Butte district occur near the surface, in the oxidized zone, or above the natural water level of the locality. Many high-grade silver ores run high in gold.

Electrum, native gold-silver, calaver-

ite, sylvanite, and the gold-silver tellurides occur in the Butte district. Most of the gold ore that comes from the small prospects is in iron-oxides siliceous gangue and about 80 to 90% of the gold can be recovered by amalgamation. When the gold ore, which is usually a "gossan," reaches the water level it often turns "base" or pyrites come in, and unless silver or copper runs with the pyrites the gold values drop. On a whole the value of free milling gold ores is confined to nearly above the water level but gold may also occur below the water level in complex combinations with the ores of copper, silver, manganese and even lead and zinc. The gold ore in this district is very spotty and most of that which is produced comes from the base sulphides.

SILVER ORES.

Pyrargyrite and proustite (the dark and light ruby silver), occur both as primary ores and in tetrahedrite. Native wire silver, silver crystals and cubes (pseudomorphs after pyrite and galena) are found. Silver occurs in many forms in this district. Argentite, stephanite, polybasite, and the chlorides (horn-silver and Cerargyrite) are found, often alone, but commonly associated with pyrite, also found in the copper, zinc, lead, and manganese deposits.

COPPER ORES.

Chalcocite, enargite, and bornite are the most important copper ores. Covel-



The Butte Hill looking northwest—"The richest hill in the world." The underground development in the Butte City district is by vertical shafts. Both steam and electricity are used as power for hoisting. Double and triple apartment shafts are the rule in this area.



A miner at work—drifting with a water-leyner. These heavy machines are used chiefly for drilling tunnels and drifts. Note the carbide lamp on the miner's head—it's the only light he has.

lite, chalcopryrite, tetrahedrite, brochantite, and chalcantinite are present in all of the Butte mines. Chalcantinite (copper sulphate) is deposited by mine waters upon timbers, gouge, and wall rock. This copper water is the present day mineralizer that may be observed working in the Butte mines.⁴

Malachite and azurite (the green and blue carbonates of copper) are found in the surface or oxidized zones. These carbonates are more often associated with the oxide and silicate deposits, than with the sulphides, in this district. Cuprite, the ruby oxide of copper; melaconite, the black oxide; tenorite, a variety of melaconite; and chrysocolla, the copper silicate, are common surface minerals.

Some native copper is found in both the upper and deeper deposits of the Butte district, and usually as small specimens. Microscopic crystals of gold and silver are often found on the copper and occasionally both occur on the same piece of copper. Other crystals found deposited on copper are quartz, cuprite and melaconite.

Many of the copper minerals are showy and make very attractive specimens for a mineral cabinet. Such specimens, unfortunately, are rare in the Butte district, though typical ore specimens are easy to obtain.

With the method of mining in the larger working of the Butte district, the great majority of excellent mineral specimens are lost, except the few that are "high-graded" by lovers of minerals. To those in charge, specimens represent so much mineralization—a certain per cent of copper—so many ounces of silver—nothing more. From the mine dumps, however, many specimens can often be obtained that are of excellent quality. As an average, the dumps will carry $\frac{1}{2}\%$ copper, with various amounts of other metallic and non-metallic minerals. It is now the practice to hoist no more waste-rock than necessary—this being used underground for filling in worked-out places. Now and then some rock is hoisted and dumped and these may often reward a collector with interesting specimens. The ore-bins often afford a collector a means of acquiring some good specimens.

LEAD AND ZINC ORES.

Copper is the leading ore and lead and zinc are the second ores in economic value of the Butte district. The para-

genesis of the Butte district ores is very complex. Ideas have changed with new developments and no doubt the accepted geological standards of today will make way tomorrow to new ones which may be brought to light with further exploration and investigation.

Galena and sphalerite are associated together in the Butte district, both in the upper regions and in the deeper level veins. Some of these lead-zinc veins carry copper, often in amount as high as 10%. This mixture is known as the "complex Butte Sulphide" which before the advent of flotation caused a great deal of trouble for the metallurgist.⁵

Associated with the galena and sphalerite, and altered from them, are the carbonates, oxides, and silicates of lead and zinc. Silver is invariably associated with the sulphide ores of lead and zinc and sometimes amounts to as much as 5,000 ounces per ton of ore.

MANGANESE ORES.

Montana has many resources of manganese ores that are but partly developed. The manganese production in the Butte and nearby districts will no doubt greatly increase in a few years when necessity or demand may warrant greater production.

Rhodonite and rhodochrosite are commonly associated with some of the ores in the Butte district. These minerals are found also in copper veins. Psilomelane and manganite are analogous to the minerals that occur in the oxidized zone of copper ores. Franklinites, hausmanite, and pyrolusite are also found together with tungsten-manganese minerals, hubnerite, wolframite, and columbite, which are somewhat rarer. Some of the manganese minerals in this district run high in silver, and a few in gold and silver.

GENERAL NOTES.

Iron pyrite is found in all the sulphide veins of the Butte district. While the veins are definitely considered replacement deposits, there is some doubt as to the role of chalcocite, it being considered a primary mineral by some authorities and by others a secondary mineral.⁶ Some of the copper carbonate deposits are of secondary genesis and generally represent an impregnation process rather than a replacement.

In any area of about 80 miles long and 15 to 20 miles wide, in the Cordil-

leran or adjacent ranges, a great variety of minerals may be found. This is especially true of the Butte district, with its well-known vein systems explored to a depth of about 4,000 feet below the surface. What lies beyond the present workings only the future will tell.

There are fewer mines now working than formerly, but this is because of the consolidation of the different mines and not so much to the absence of ore. If ore can still be obtained at greater depth than which the present equipment will hoist from, namely about 5,500 feet, the disadvantages of temperature at this and greater depths below the surface, can be readily overcome by natural and artificial refrigeration, cooling and forced circulation of the air, and possibly the addition of nascent oxygen to the air.

From the standpoint of production, the Butte district is about 65 years old, but from developments, within the realm of possibility, the district production is just entering its infancy.

Possibly in a century or so, when the mines are 3 or 4 miles deep, the ore may be shot to the surface with divivified underground compressed air; liquified oxygen may be used in place of dynamite; artificial refrigeration may keep the underground temperature at a comfortable average; the dust precipitated by electricity; the drilling accomplished by electric drills; all mucking done by machinery; the underground workings fire-proofed from collar to sump—because pillars, stulls, bulkheads, cribbing, lagging, posts, caps, etc., will be made from a special cement derived from waste-rock and tailings; accidents eliminated;

phthisis overcome, because there will be nascent oxygen added to, and not taken from the air; electric "cold-light" used in place of candles and carbide, etc.; and with these and other inventions that may come to pass, the miner and underground worker may accomplish 10 or 20 times the amount of work that is being done at the present day and with half the effort, one-third the time, and at one-tenth the cost.

REFERENCES.

1. Estimate of C. N. Gerry, U. S. Bureau of Mines, Department of Commerce, Washington, D. C., 1928.

According to the estimates of George B. Conway, Mining Engineer of Helena, Mont., the value of copper, silver, gold, zinc, lead, manganese, coal, and precious stones recovered in Montana from 1862 to 1925 totals \$12,290,953,336. The total value to 1925 of petroleum, cement, gypsum, corundum, clay, phosphates, and other non-metallic minerals amounts to \$2,500,000,000.

2. The early history of the Butte district and of Montana itself, is a record of mining developments and by-incidents. Gold was discovered in 1852 by a French half-breed named Finley or Benetsee. In 1858, along Gold Creek, northwest of Butte, the first gold discovery of any importance was made; from then on Montana ranked with California as the prospector's "happy hunting-ground." Gold was the only metal sought for in the early days of the West.

3. Replacement veins are courses along which the wall-rocks are replaced by vein matter; therefore, formed by



The Continental Divide, five miles northeast of Butte, Montana. A study in erosion.



Chain Lakes, Meadow Creek, Montana. The lower lake is formed by a fault dam, while the upper lake is formed by detris and talus slides.

metasomatism. See Emmons, Econ. Geol., pages 218-229.

4. The copper water from the mines is an acid copper sulphate solution which after being pumped to the surface is treated by passing over iron scraps and tin cans in dripping towers and sluices; the copper is precipitated and recovered in a dull, dusty, red, metallic form, about 90% pure; the iron replaces the copper in solution.

If copper water forms a course over and through a "gob," as the waste filling of worked-out stopes is called, it often enriches the gob so that it may be mined again as an ore.

5. The first values recovered from Butte, "the richest hill in the world," were placer gold, then lode or vein gold. Later a slump came over the district and the mines practically ceased operations until the silver veins were discovered. When copper was encountered and increased materially the old-time gold and silver miners and operators said the camp was done for. But the copper netted a profit to J. Berkin and associates who first shipped it to Wales, England, for treatment. Then followed the copper boom—fight—and consolidation. The next phase of the game came when the copper veins turned to lead and zinc—then Butte was done for right. But the flotation process of Hyde's solved the problem of separating the different metallic sulphides from one another and mining in the Butte district has been revived and stimulated again.

6. Emmons, Prin. Econ. Geol., page 365.

ECONOMIC MINERALS OF THE BUTTE DISTRICT

Arsenic Minerals

Tetrahedrite
Enargite
Proustite
Arsenopyrite

Copper Minerals

Chalcocite
Bornite
Chalcopyrite
Tetrahedrite (see under Arsenic)
Enargite (see under Arsenic)
Cuprite
Malachite
Azurite
Chalcanthite
Chrysocolla

Gold Minerals

Native gold
Electrum
Calaverite
Sylvanite

Iron Minerals

Pyrrhotite
Pyrite
Marcasite
Hematite

Lead Minerals

Galena
Cerussite
Anglesite

Manganese Minerals

Rhodochrosite
Rhodonite
Pyrolusite
Manganite
Franklinite (see under zinc)
Wolframite
Columbite

Silver Minerals

Native silver
Argentite
Proustite (see under Arsenic)
Pyrargyrite
Cerargyrite

Zinc Minerals

Sphalerite
Zincite
Smithsonite
Willemite
Franklinite

The above list includes practically all of the ore minerals of the Butte district. Many traces of other elements are found and often recovered in the process of refining the above ores.

The chief ore of copper is chalcopyrite, often called copper pyrites.

Mercury is the only metal in a liquid form.

Norway is famous for its rare minerals.

Ceylon is famous for its gem stones.

Halite is the only mineral used as food (table salt).

Sweden is famous for its iron deposits.

HOW THE STATES RANK IN MINERAL PRODUCTION

Pennsylvania, with its tremendous output of coal, continues to lead all the states of the Union in the production of minerals, according to a tabulation just made public by the United States Bureau of Mines, Department of Commerce. In addition to coal, cement, clay products and natural gas contributed heavily to the Keystone State's mineral production amounting to \$1,055,766,000 in the year 1926. Petroleum is mainly responsible for the attainment of second, third and fourth places by the States of Oklahoma, California and Texas. Oklahoma's production of \$569,519,000 was also heavily

contributed to by natural gas and zinc. Natural gas and cement were considerable factors in California's output of \$523,352,000, while sulphur and natural gas swelled the Texas State total of \$429,587,000.

The eastern States of West Virginia, Ohio and Illinois, all large coal producers, ranked fifth, sixth and seventh, with the item of clay products outranking coal in the Ohio production. Other especially notable mineral producing States were Kansas, Kentucky, Michigan, Indiana, Minnesota, Arizona and New York. Every State is included in the list of mineral producers. A detailed tabulation follows:

MINERAL PRODUCTION OF THE DIFFERENT STATES, 1926

State	Principal Mineral Products	Amount
Pennsylvania	Coal, cement, clay products, natural gas	\$1,055,766,000
Oklahoma	Petroleum, natural gas, zinc	569,519,000
California	Petroleum, natural gas, cement	523,352,000
Texas	Petroleum, sulphur, natural gas	429,587,000
West Virginia	Coal, natural gas, petroleum, clay products	395,942,000
Ohio	Clay products, coal, natural gas, petroleum	253,884,000
Illinois	Coal, clay products, petroleum, cement	237,242,000
Kansas	Petroleum, zinc, natural gas, coal	165,061,000
Kentucky	Coal, petroleum, clay products, natural gas	146,768,000
Michigan	Iron ore, copper, cement, salt	130,861,000
Indiana	Coal, cement, stone, clay products	118,692,000
Minnesota	Iron ore, stone, cement, clay products	118,361,000
Arizona	Copper, gold, silver, lead	115,048,000
New York	Clay products, gypsum, cement, stone	112,016,000
Utah	Copper, lead, silver, coal	98,985,000
Missouri	Lead, clay products, cement, coal	90,004,000
Arkansas	Petroleum, natural gas, coal	84,486,000
Alabama	Coal, iron ore, cement, clay products	83,710,000
Montana	Copper, zinc, petroleum, silver	79,763,000
Wyoming	Petroleum, coal, natural gas	78,988,000
New Jersey	Clay products, zinc, cement, stone	77,066,000
Colorado	Coal, gold, lead, petroleum	65,597,000
Louisiana	Petroleum, natural gas, sulphur	62,204,000
Virginia	Coal, clay products, stone, cement	46,136,000
Tennessee	Coal, cement, clay products, stone	39,297,000
Iowa	Coal, cement, gypsum, clay products	35,972,000
Idaho	Lead, silver, zinc, stone	31,753,000
New Mexico	Copper, coal, petroleum, zinc	28,514,000
Nevada	Copper, silver, gold, lead	27,613,000
Maryland	Coal, clay products, cement, sand and gravel	24,067,000
Washington	Coal, cement, clay products, sand and gravel	21,257,000
Wisconsin	Stone, zinc, sand and gravel, iron ore	20,712,000
Florida	Phosphate rock, stone, sand and gravel, fuller's earth	19,752,000
Alaska	Copper, gold, coal, silver	17,607,000
Georgia	Clay products, stone, cement, fuller's earth	17,480,000
Massachusetts	Stone, clay products, sand and gravel, lime	16,787,000
Vermont	Stone, slate, lime, talc	14,955,000
North Carolina	Clay products, stone, sand and gravel, feldspar	10,993,000
Connecticut	Clay products, stone, lime, sand and gravel	7,695,000
South Dakota	Gold, cement, stone, sand and gravel	7,595,000
Oregon	Stone, cement, sand and gravel, clay products	6,941,000
Maine	Stone, lime, slate, clay products	5,786,000
New Hampshire	Stone, clay products, sand and gravel, feldspar	4,145,000
South Carolina	Clay products, stone, sand and gravel, barite	3,677,000
Nebraska	Clay products, sand and gravel, cement, stone	3,322,000
North Dakota	Coal, sand and gravel, clay products	2,805,000
Mississippi	Clay products, sand and gravel, stone	1,833,000
Rhode Island	Stone, clay products, sand and gravel, lime	1,329,000
Dist. of Columbia	Sand and gravel, clay products, sand-lime brick, stone	987,000
Delaware	Stone, clay products, sand and gravel	378,000

STARK'S KNOB

By C. A. HARTNAGEL,

Assistant State Geologist, Albany, N. Y.

Stark's Knob, which is both of unusual geological and historical interest, is a small dome-shaped volcanic knoll located in the town of Northumberland, Saratoga County, New York. It is unlike any known occurrence of igneous rock in the State, and was originally described as the Northumberland Volcanic Plug by Professor J. B. Woodworth, who, in 1901 was the first to recognize its igneous nature, and by whom the name Stark's Knob was given.

Stark's Knob, which is nearly circular in outline, has an extreme diameter of not over 600 feet and a height of about 75 feet. It is entirely surrounded by dark Normanskill (Hudson River) shale of Ordovician age. With the exception of the igneous mass, the entire region is made up of fossiliferous shales and limestones. The nearest exposure of Precambrian igneous and metamorphic sedimentary rocks are ten miles west of the knob where they constitute the southeast border of the Adirondacks. In the Precambrian area the youngest type of rock are the diabase or trap dikes, some of which are several miles in extent.

Quarrying operations which were formerly conducted on the east side of Stark's Knob, have resulted in bringing to view a section of the interior of the knob and thus exhibiting a number of complex structural features. As described by Woodworth,¹ "The exposed faces exhibit cross sections of ball and pear shaped masses embedded in a base having a shaly structure. The crust of these balls consist of a layer of dense, dark colored basic rock of the diabase type, surrounding a variable nucleus of ashy, rather porous, pumiceous looking lava in most cases, and more rarely an included marginally absorbed fragment of white, semi-crystalline limestone."

"The line of demarcation between the

three elements in the rock structure is usually very sharp, and, where the shaly, fine grained base has peeled away from the surface of the lava balls, the surface of the latter resembles the coarse, bulging flowage surface of basalt streams, such as seen in Hawaii. The whole has the appearance of a mass of bombs or lava balls, inclosing scoriaceous lava, or foreign inclusions embedded in a basaltic glass which has devitrified and is scaling to pieces along lines of flowage. A more probable explanation of the structure is that this mass represents a volcanic throat or plug at some depth below the actual vent or crater but not below the point to which explosive products may have fallen back in the volcano there to become embedded in still hot lava. Certainly the gross structure of the rock recalls many lava sheets with locally formed explosive products, and the same structure is to be observed in the lava flows of the Newark formation of Triassic age in the Connecticut Valley."

Many of the ball and pear shaped masses, which in size range from a few inches to two feet, are still to be found at the base of the quarry where they were left when the quarry ceased to be operated. As a result of severe compression and dislocations, the entire volcanic mass shows abundant slickensides, and there is scarcely a specimen of the lava balls or intervening material that does not show this feature. Cracks filled with secondary calcite are also abundant and these show the deformation to which the rock has been subjected since cooling. The presence of calcite veins in the bombs make it possible to break them with but little difficulty.

The limestone fragments in both the round masses and the intervening material are of special interest. Although the knob is surrounded by black shales, no clearly defined shale inclusions have been found in the volcanic mass. Some large masses of wedge shaped shale

(1) 21st Report New York State Geologist for 1901 (1903), p. r20.

found in the knob are presumably due to faulting of the shale material. The included limestone fragments, the largest of which measure one foot in diameter, are all of the same type of rock, a rather pure limestone quite unlike the limestone which outcrops a few miles to the southwest of the knob. The included fragments in many respects resemble the Bald Mountain limestone which outcrops three miles east and normally occurs beneath the Normanskill shales which at present surround the knob. As to whether the knob is actually in place or whether it was moved to its present position as a result of overthrusting has not been satisfactorily determined. The age of the knob is also in some doubt. Professor H. P. Cushing,² who has given considerable study to Stark's Knob, in a summary writes, "The only definite statement that can be made concerning the knob is that it consists of a small mass of lava of effusive type. If it is in place it seems surely a volcanic neck or throat; if not in place it may be a fragment of a surface flow, overthrust from some locality to the east. If in place, it is younger than the date of the overthrusting; if not in place, it is older. If not in place, we have no idea whence it came, nor are any other fragments known. It has some features in common with certain Newark trap flows and is like some of them in composition, though the composition differs from that of the average Newark trap. Clear structural evidence of much shearing and faulting of the knob, of such type as to indicate deformation under load, leads to the conviction that the lava can not be an especially recent one."

(2) New York State Museum Bulletin 169, p. 135 (1914).

Historical Significance of Stark's Knob

Stark's Knob is situated at the north edge of the Saratoga battlefield, one-fourth mile west of the Hudson River, and about one and one-half miles north of the battlefield monument at Schuylerville (old Saratoga), the place of the surrender of Burgoyne.

After the two battles of Saratoga, fought some eight miles south of Stark's Knob, Burgoyne slowly withdrew his army toward the north and prepared a fortified camp at Schuylerville. In the meantime, the American armies were engaged in surrounding the British. To the south was the army of General Gates; on the bluffs on the east side of the Hudson River were Fellow's batteries and on the west Morgan's sharpshooters. The only avenue of escape left for Burgoyne was at the north in the one-fourth mile stretch between Stark's Knob and the Hudson River. Orders had been issued by Burgoyne on October 12, 1777, for a retreat of his army through the as yet unoccupied opening at the north. Late in the evening the order to march was countermanded and the army did not move. The same night General John Stark mounted a battery on the knob which now bears his name, and with his troops, completed the ring around Burgoyne's army. Being now completely hemmed in, Burgoyne surrendered October 17, 1777.

Stark's Knob is now a State Reservation. The quarry operations, which at one time seriously threatened to entirely destroy this natural monument, have been permanently suspended. In 1916, through the generosity of the late Emerson McMillin, Stark's Knob was purchased and transferred to the custody of the State Museum, and in 1927 was taken over by the State Conservation Commission.

Gilsonite, one of the world's oddest minerals, is mined only in the State of Utah, according to the United States Bureau of Mines, Department of Commerce. It is a brilliant, black, asphaltic substance, and is used in the manufacture of varnish, paint, electrical insulation, inks, telephone mouthpieces, electric switch

handles, and knobs and buttons of various kinds. The transportation of gilsonite to the consuming public is started over one of the steepest and most crooked railroads in the world, which crosses the Book Cliffs at Baxter Pass at an elevation of 8,437 feet, trains actually traveling 24 miles between points only 6 miles distant by air line.

PALEONTOLOGY DEPARTMENT

Conducted by
BENJAMIN T. DIAMOND, M.A.

Mr. Diamond will gladly assist subscribers in identifying their fossil specimens or answering any questions pertaining to fossils. Please write to him direct, enclosing enough postage if a personal reply is desired, specimens returned, etc. Address all mail as follows: Benjamin T. Diamond, M.A., 467 Riverdale Ave., Brooklyn, N. Y.

MOLLUSCOIDEA

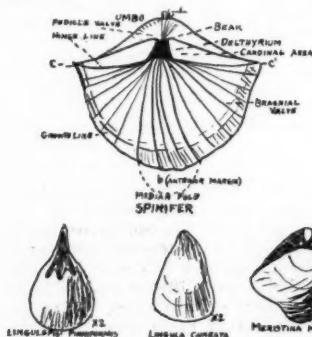
We shall consider in this article the bivalved Molluscoidea (English, Mollusca and Greek, Eidos—form like a Molluscan). The Brachiopoda are the most important and best representatives of this Phylum.

The Brachiopoda are marine animals secreting a shell of calcareous or phosphatic material. These shells are characterized by 1—being equilateral, 2—being inequivalved (usually both valves are convex, but they may be nearly flat), 3—pedicle opening present (except in *Atrēmata*), 4—teeth in one valve, sockets in the opposite valve (except in *Inarticulata*), 5—no ligament present, valves opened by muscles, 6—valves dorsal and ventral.

Structures: There are two valves, the pedicle or ventral valve and the brachial or dorsal valve. On these we find 1—growth lines or concentric markings, denoting periodic deposition of the shell material, 2—plications, which are longitudinal folds of the entire thick-

ness of the shell as contrasted with 3—striations, which are secondary longitudinal growths on the surface of the shell, 4—a medial sinus and fold (the sinus is a central-folding of the shell forming a depression, whereas the fold is a folding of the shell to form a ridge), 5—hinge line, which is the line of articulation of the shells, 6—the cardinal area of the flattened or curved triangular area, which is often observable between the hinge line and the beak. It is more highly developed in the ventral than in the triangular delthyrium.

On the inside of the shells we find in the pedicle valve the teeth while the sockets are in the brachial valve. The teeth fit into the socket and are there to aid in articulation. Also we now find the brachidia which are calcareous supports for the brachia, these are usually prolonged basally from the crura which are two short curved processes attached to the hinge plate of the brachial valve and to which the brachia are attached. When these are united they are known as the cruralium.



FOSSIL BRACHIOPODA.

The length or height of the shell is the distance from the hinge line through the middle of the shell to the opposite edge or front. The width is the greatest distance in the direction at right angles to the length. The thickness is the greatest distance perpendicular to the plane of length and width.

Brachiopoda are divided into two classes each consisting of two orders:

Subclass 1—**Inarticulata**: No teeth and sockets.

Order 1—**Atremata**: No pedicle opening.

Order 2—**Neotremata**: Pedicle opening confined to pedicle valve.

Subclass 2—**Articulata**: Articulation by teeth and socket.

Order 1—**Protremata**: Pedicle opening confined to pedicle valve, no brachial support except short ones.

Order 2—**Telotremata**: Pedicle opening shared by both valves, brachial supports present.

Geologic Range of Brachiopoda: Cambrian to present. Maximum development in Silurian and Devonian.

Subclass—**INARTICULATA**.

Order 1—**ATREMATA**.

Lingulepis pinniformis—Potsdam of New York. Pedicle valve spatulate, posterior portion acute, tapering, anterior portion rounded, brachial valve without tapering part, surface with concentric stria.

Lingula cuneata—Medina of New York. Wedge shaped. Valve convex, posterior half but flattened anteriorly. Surface longitudinally striated.

Order 2—**NEOTREMATA**.

Acrotreta gemma—Cambrian. Very small, brachial valve circular and nearly flat, pedicle valve acutely conical with flat triangular area whose base forms half the width of the shell.

Schizobolus concentricus—Genesee. Very small, broader anteriorly and with posterior margin rounded or truncated, surface marked by five concentric stria and with faint radiating lines.

Subclass—**ARTICULATA**.

Order 1—**PROTREMATA**.

Leptaena rhomboidalis—Trenton. Small, semicircular, cardinal extremities extended, pedicle valve slightly convex near the hinge, slightly concave just before the deflection.

Plectambonites sericeus—Trenton. Pedicle valve convex in center deflected at edge, surface covered with fine stria crossed by a few concentric ones.

Schizophoria striatula—Devonian. Pedicle valve with a broad undefined sinus, brachial valve sinuate in front, surface very finely striated.

Order 2—**TELOTREMATA**.

Dielasma bovidens—Shells elongate, ovate, pedicle valve strongly arcuate with incurved beak and broad medial sinus, surface nearly smooth.

Meristina maria—Niagaran. Biconvex, beaks incurved, pedicle valve with a corresponding fold, surface marked with concentric growth line.

To all my readers who write me I will send free a perfectly preserved Brachiopod.

THE PICTURE ON THE COVER

The illustration on the cover of this issue of **ROCKS AND MINERALS** is of Stark's Knob, the only volcanic remains that are known in New York State. The Knob is about two miles north of Schuylerville and about 10 miles northeast of Saratoga Springs (East-center of New York State) and offers an interesting pilgrimage for the student of geology. The geologic structure is most interestingly explained in the article contributed to this issue by C. A. Hartnagel, Assistant Geologist of the State

of New York. Mr. Hartnagel has also touched upon the historic importance of this knoll.

The preservation through the ages of this volcanic knoll made it possible, in a critical crisis, to cut off any retreat of General Burgoyne's army and brought about a surrender which had much to do with the final victory of Continental troops over British soldiery and effecting the birth of a new nation upon the North American Continent.

A COMPILATION OF GEM NAMES

By GILBERT HART

P. O. Box 2005, Birmingham, Ala.

Mr. Hart and ROCKS AND MINERALS will be glad to have readers send in additional gem stone names not here included or suggestions as to any corrections in names which they believe should be made.

This is a continuation of the very interesting compilation of gem names (the largest ever printed) made by Mr. Hart, the first installment of which appeared in the December, 1927, issue of the magazine. This list will be continued until completed.—The Editor.

Chalchithuitl—a Mexican gem, supposed to have been applied to various blue or green stones, especially calamine, also turquoise, emerald prase, green jasper, jadeite; also called Aztec Stone.

Chalchuite—turquoise, green.

Changeant—labradorite.

Chert—quartz, compact rock-forming variety, includes flint, jasper and hornstone.

Chessy Copper—azurite.

Chessylite—azurite, the usual name in England for this mineral.

Chesterlite—microcline, from Chester County, Pennsylvania.

Chiaistolite—andalusite, with internal cross-like markings due to symmetrically arranged carbonaceous impurities.

Chinarump—quartz, Indian name for petrified wood.

Chiorastrolite—prehnite or thomsonite, usually impure.

Chloromelanite—jadeite, dark green to black.

Chloropal—opal, green from Silesia.

Chlorophane—fluorite, phosphoresces with a greenish tint when slightly heated as by friction or bodily heat.

Chlorospinel—spinel, green.

Chlor Sapphire—corundum, bluish to greenish.

Chlorspinel—spinel, green.

Chlorutahlite—variscite, compact.

Chondrodite—monoclinic, usually massive; red, brown or yellow; hardness 6 to 6.5, specific gravity 3.25; silicate of magnesium with fluorine or hydroxyl.

Christianite—anorthite, from Vesuvius.

Chrome Diopside—diopside, bright green, with 3 per cent. or less chromium.

Chrome Garnet—uvarovite.

Chrome Tourmaline—tourmaline, green, may be colored by chromium.

Chromic Iron—chromite.

Chromite—isometric, usually massive or granular; brown to black; hardness 7 to 8, specific gravity 4.5; chromate of iron, with magnesium or aluminum.

Chrysoberyl—orthorhombic, prismatic crystals, usually various shades of green; hardness 8.5, specific gravity 3.6; aluminate of beryllium; also named as follows: **Alexandrite**, **Cat's Eye**, **Ceylon Cat's Eye**, **Chrysolite**, **Cymophane**, **Floating Light**, **Opalescent Chrysolite**, **Oriental Cat's Eye**, **Oriental Chrysolite**, **Ural Chrysoberyl**.

Chrysoberyllus—beryl, honey to wine yellow.

Chrysocarmen—oxidized copper ores, a mixture of jasper, quartz, chalcodony, hematite, chrysocolla and malachite.

Chrysocolla—massive and botryoidal, green or blue; hardness 2 to 4, specific gravity 2.24; a hydrous copper silicate; ornamental varieties are also called **Keystoneite**, **Siliceous Malachite**.

Chrysolithus—beryl, a pale yellowish green.

Chrysolite—olivene; (2) also refers to chrysoberyl, not in usual nomenclature; (3) used with various prefixes or suffixes in reference to any olive green stone, or to light greenish yellow.

- Chrysolite of Brazil**—tourmaline, green and transparent.
- Chrysoprase**—apple green chalcedony, translucent.
- Cinnabar**—rhombohedral, habit tabular to massive, bright red; hardness 2, specific gravity 8.00; sulphide of mercury.
- Cinnamonite**—grossularite, essonite variety.
- Cinnamon Stone**—grossularite, essonite variety.
- Citrine**—quartz, pellucid golden-yellow.
- Citrine Quartz**—quartz, this term is applied to the massive yellow quartz, while the next above may be limited to the crystals.
- Citrini**—corundum, yellow, old term not now in vogue.
- Cleavelandite**—albite, lamellar, bluish white.
- Clouded Agate, Cloudy Agate**—quartz, agate with colors irregularly clouded.
- Clouded Chalcedony, Cloudy Chalcedony**—chalcedony with dark clouded spots on a transparent light gray-blue base.
- Cobaltite**—Isometric, usually massive, pyrite yellow; hardness 5.5, specific gravity 6.25; arsenide of cobalt.
- Cobra Stone**—fluorite, alternate name for chlorophane.
- Cockle**—tourmaline, black.
- Colophonite**—andradite, brownish-black, resinous luster; (2) vesuvianite.
- Colorado Ruby**—pyrope, especially from Colorado.
- Colorado Topaz**—quartz, citrine; (2) topaz, from Colorado.
- Common Opal**—opal, translucent, slightly colored, without play of colors.
- Comptonite**—thomsonite from Vesuvius.
- Congo Emerald**—diopase, from the Congo.
- Copper Emerald**—diopase.
- Copper-ore Gem**—mixtures of various copper minerals which may have enough beauty to be satisfactorily cut and polished as ornamental stones, such as malachite, chrysocolla, azurite, cuprite, diopase or mixtures of them.
- Copper Pitch Ore**—compact brown to black mixture of iron and copper oxides.
- Coradgee Stone**—quartz, rock crystal.
- Coral**—the hard calcareous internal structure secreted by various marine animals; several varieties are known, most prized being red coral.
- Coral Agate**—quartz, coral replaced by silica.
- Coralloidal Aragonite**—aragonite in delicately interlacing groups snow-white and resembling coral.
- Cordierite**—orthorhombic, granular or massive, usually blue; hardness 7 to 7.5, specific gravity 2.61; hydrous silicate of aluminum and magnesium; gem names: **Dichroite, Iolite, Lynx Sapphire, Lynx Stone, Peliom, Prismatic Quartz, Saphir d'Eau, Spanish Lazulite, Steinheilite, Violet Stone, Water Sapphire.**
- Cornelian**—quartz, a translucent red chalcedony.
- Cornflower Sapphire**—corundum, choicest blue sapphire, especially that from Montana.
- Cornish Diamond**—quartz, rock crystal from Cornwall, England.
- Corundum**—hexagonal, usually barrel-shaped combination of prism and pyramid; colors varied, when unweathered usually brown to green; hardness 9, specific gravity about 4.00; oxide of aluminum; gem names: **Adamantine Spar, Amethyste Oriental, Anthrax, Apyrote, Armenian Stone, Asteria, Asteriated Sapphire, Asteriated Topaz, Asterie, Australian Sapphire, Barklyite, Bleu du Roi, Blue Sapphire, Bronze Corundum, Burmah Ruby, Cat Sapphire, Ceylon Ruby, Ceylon Sapphire, Chlor-sapphire, Citrini, Cornflower Sapphire, Corundum Cat's Eye, Cowee Ruby, Diamond Spar, Emerald, Female Sapphire, Girasol, Golden Sapphire, Green Sapphire, Hyaline, Kashmir Sapphire, King Topaz, Lenco-sapphire, Luchs Sapphire, Lynx Sapphire, Male Sapphire, Montana Sapphire, Occidental Amethyst, Opalescent Sapphire, Opaline, Oriental Amethyst, Oriental Aquamarine, Oriental Cat's Eye, Oriental Chrysoberyl, Oriental Chrysolite, Oriental Emerald, Oriental Girasol, Oriental Hyacinth, Oriental Moonstone, Oriental Peridot, Oriental Ruby, Oriental Sapphire, Oriental Smaragd, Oriental Sunstone, Oriental Topaz, Pearl Corundum, Pigeon Blood Ruby, Pink Sapphire, Red Stone, River Sapphire, Ruby, Rubin Etoile, Sagenitic Corundum, Salam-**

- stone, Sapphire, Siam, Siam Ruby, Star Ruby, Star Sapphire, Star-Stone, Star Topaz, Topaz Cat's Eye, White Sapphire, Yellow Sapphire, Yogo Sapphire.
- Corundum Cat's Eye**—corundum, with variously colored reflections of light from within stone.
- Cotterite**—quartz, metallic-pearly luster.
- Covellite**—hexagonal, habit massive, color bright indigo blue; hardness 1.5 to 2, specific gravity 4.6; sulphide of copper.
- Cowee Ruby**—corundum, ruby from Cowee Valley District of North Carolina.
- Cream**—sepiolite, an iron-stained meerschaum.
- Creoline**—purple epidotized trap rock, from Massachusetts.
- Creolite**—jasper, banded, from Shasta County, Calif.
- Crimson Night Stone**—fluorite, purple.
- Crispite**—quartz, sagenitic.
- Crocalite**—natrolite, red, in amygdules.
- Crocidolite**—member of the amphibole group of silicates, usually fibrous or massive, various shades of blue; hardness 4, specific gravity 3.25; silicate of sodium and iron; usually crocidolite which is used as a gem is more or less completely replaced by silica, which retains the blue color.
- Cross Stone**—andalusite, chiastolite; (2) staurolite, twins.
- Crucite**—andalusite.
- Cryptoperthite**—feldspar, laminated albite and orthoclase, schillerizes.
- Crystal**—quartz, rock crystal.
- Cupid's Darts**—quartz, needle-like inclusions of goethite.
- Cuprite**—isometric, octahedral or massive; hardness 4, specific gravity 6.00; oxide of copper.
- Cyanite**—this spelling is adopted by recent American mineralogists for the mineral more usually known as kyanite.
- Cyclopit**—anorthite, transparent glassy.
- Cyclops**—quartz, eye-agate with a single eye.
- Cymophane**—chrysoberyl in which a bright spot of light seems to float over the surface as the stone is moved.
- Cyprine**—vesuvianite, bright green.

THE GEM DEPARTMENT

Conducted by
GILBERT HART

Each issue Mr. Hart will give in this department information concerning gems and gem minerals. As Mr. Hart invites correspondence relating to the department, letters should be addressed to him as follows:

Gilbert Hart, P. O. Box 2005, Birmingham, Ala.

STAUROLITE

Staurolite is one of the commoner minerals used as a gem on account of its peculiar structure. The earliest references I have noted in which this mineral is described are notes by de Robien and Cronstedt about 200 years ago, where "cross-stones" are mentioned in connection with baptismal rites in various parts of Europe. The church-men called these mineral crosses "Lapis Crucifer" and connected them with the chief Chris-

tian symbol, the CROSS, particularly prizing them in their native state.

Staurolite received its present scientific name in 1792 when its independence was recognized by mineralogists. It is a rather complex silicate mineral, usually found with many impurities. It appears to have a strong crystallizing power, as it is very rarely found other than in crystals, and these are mostly of 4 to 6 pairs of faces. Staurolite is orthorhombic in symmetry, and usually shows a

four or six-sided prism, capped by a flat base or a simple dome. The crystal faces are often rough, with a sanded appearance which together with the dull brown to brownish gray color resembles a fine grained sandstone. It is a brittle mineral, with a poor cleavage parallel to the prism. In hardness it is between topaz and beryl, but it alters readily when freed from its matrix, so that the crystal surfaces may show hardness well below 7. Pure varieties have a specific gravity of 3.75 to 3.78, which is considerably lowered by impurities and hydration. Beneath its dull exterior, the mineral is of resinous or vitreous luster, and often the color shows as an interesting red-brown like andradite. With the dichroscope, and small specimens, staurolite shows a red and yellowish green pair of colors, or yellow and almost colorless, depending on the depth of color in the specimen. Its refractive index is about 1.75, and the refractometer will show a birefringence of 0.01.

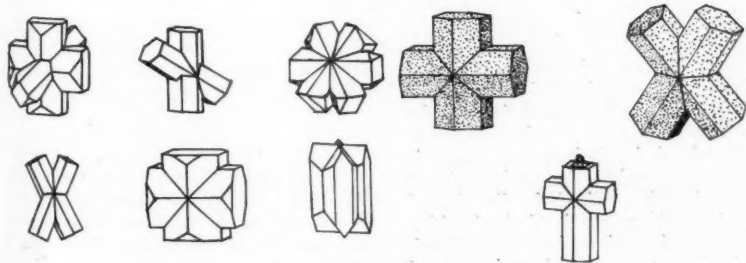
These characteristics will serve to distinguish staurolite; but usually the twin-crystals are the gem-varieties and are so unique as to need no instrumental aids for identification. Two common types of twins are used in jewelry; one shows the arms at nearly 90° , and when well-formed is often trimmed in gold for use as a pendant. The other type has arms at 60° , and is sold to a less extent than the former, though nearly as common in nature. Rarely the pure staurolite has

been faceted and used as a stone which closely resembles garnet. This red or brown gem is called "grenatite" from this resemblance.

In the Middle Ages use was made of staurolite twins as charms, which through their unusual form were deemed capable of working miracles in everyday life. The superstition still exists, and today these natural crosses are called "lucky stones" or "fairy stones."

The most important American locality of recent years has been Patrick County, Virginia; whence came many of the finely proportioned twins which were marketed a few years ago. Forty years earlier many were found in Georgia; Fannin County being the headquarters of the gem hunters.

Staurolite is a fairly common mineral, usually formed by metamorphic action of heat on clay slates. It is found in many places in New England and southwards along the crystalline rocks of the Appalachians. Similarly it occurs in the West, associated with the altered sediments of the Cordillera; and in the isolated areas of metamorphic rocks in Arkansas and Texas. It is found in this same type of rock throughout the world. Usually it is found twinned, but often simple crystals are noted. As a rule the twinned individuals are of unequal development; and the symmetrical specimens as those from Patrick County are rare enough to command value as curios.



STAUROLITE TWIN-CRYSTALS

THE STORY WE READ IN THE ROCKS

By MISS ELEANORE V. PROKES

Jackson, Minn.

A Senior Class Essay of the Peace Memorial High School, Jackson, Minn.

The history of the earth as read from the rocks deserves, next to literature, to become popular since it opens up so vast a field of fascinating thought. Of all sciences it is the youngest (in study), and may almost be said to have been born in the present century.

While it is true that knowledge concerning the structure of the earth had been accumulating ever since the time of the Greeks and Romans and that it became more abundant and better organized throughout the ages following, yet it was not until the end of the Eighteenth century that this knowledge took form as a distinct branch of science.

First born among the continents—America—so far as her physical history is concerned, has been falsely denominated the New World. At the time when Europe was represented only by small islands rising here and there above the level of the sea, America already stretched an unbroken line of land from Nova Scotia to the Far West and hers was the first shore washed by the ocean that enveloped the earth. For ages, Nature worked upon a bare continent and slowly, so slowly that a passing century saw no change, she won her victory.

Fossils tell us plain stories; tracks of animals and impressions of leaves in the rocks tell of the fauna and flora of the ancient past; wave marks, large or small, tell of the furious gale or gentle breeze that washed the ancient shore; while rain prints tell of the direction of the wind and are proofs of cloudy skies.

Masses of semi-precious stones such as the iasper, agate and opal, exposed by erosion, reveal to us the work of

storms in ages past? They tell the story of trees uprooted and scattered over the land and in time covered with deposits of sand, mud, water, and burning lava until the whole became a petrified mass.

Earthquakes, volcanoes, floods and furrowing ice, worked their way upon our land. Upturned and broken rocks, and dikes filled and overflowing with lava, tell of the earthquakes and volcanic phenomena and these now contain the richest geological records found in the crust of the earth.

We find in our rocks not only sermons but romance, poetry, and mystery. There is hardly a stone that we tread upon that has not an interesting story to tell us.

We have considered briefly some of the more important geological phenomena and materials. How and where to begin geological studies need cause no trouble, for here in Minnesota and around our very homes we can plainly see what wonders the moving ice wrought, how it plowed out lake bottoms and valleys and transported enormous rocks for hundreds of miles and in fact changed the face of the entire land over which it passed.

We live in a day of excavations and exhibitions, but the greatest treasure house of ancient lore we rarely enter, although it lies at our very door. Step by step mineralogy and geology lead us on, taking us back to the chill gray dawn of life and there pointing out to us the sea of gas wherein earth and water were one. Looking upon that picture and then on the teeming of millions around us, even the sad and lonely must thrill with expansive joy in presence of the life of the past now being unfolded before us.

A CONVENIENT ARRANGEMENT OF MINERAL SPECIMENS

By W. E. MUMFORD, *Metallurgist*

Malleable Iron Fittings Co., Branford, Conn.

Being a chemist and metallurgist of the old school, I still cling to simple nomenclature in naming and classifying my private collection. It required twenty-five years for me to make up my mind how to arrange my minerals so I could find any particular specimen quickly and unerringly. Like the old farmer who always took two handkerchiefs to church with him on Sunday, explaining that one was for "show" and the other for "blow," I have carried out the same idea in having two cabinets. The one for show occupies a prominent and conspicuous position in my home. It contains my most beautiful and attractive specimens arranged for effect and beauty. The other cabinet I resort to when I give short talks to the school children and neighbors and blow off mineralogical steam at every new find.

My study and lecture cabinets are similar to the old style spool cases with a lot of shallow drawers with narrow glass panels in front.

Clinging to the chemical features of mineralogy, I follow a group classification according to the chemical radicals. For instance, beginning with the Borates, followed by the Carbonates, then the Oxides, Phosphates, Silicates, Sulphates, Sulphides, etc., in alphabetical order, I have a good clue to location and position of any particular specimen desired. As an example, should I wish to find stibnite, I would first turn to the

sulphide group, then to the upper drawer under "A" and quickly locate antimony sulphide. Carnotite, being a vanadate, will be sought in the last part of the vanadate section, and there will be no delay in finding uranium vanadate, and so on.

I also have a duplicate cabinet with the specimens arranged alphabetically according to their common or commercial names. For example, apatite under "A", bismuthinite under "B", caesium beryl under "C", datolite under "D", erythrite under "E", etc.

While the duplicate cabinet is not wholly essential, it supplies a place for the preservation of a good duplicate piece and will be found to be very convenient, especially if one forgets the chemical composition of the sample he seeks.

Labelling is most important if one cares to standardize his system of arrangement. Localities carefully described adds an unusual interest especially when one wishes to entertain guests who inquire for minerals to be found in their respective districts.

My associate, Mr. Alfred E. Hammer of Branford, Conn., and I have featured a Connecticut cabinet with a pretty complete list of this State's contribution to mineralogy. As the saying goes, "Connecticut suggests just enough to keep prospectors poor, but not enough to enrich anyone."

CRYSTALLOGRAPHY

Conducted by
GILBERT HART

P. O. Box 2005 Birmingham, Ala.

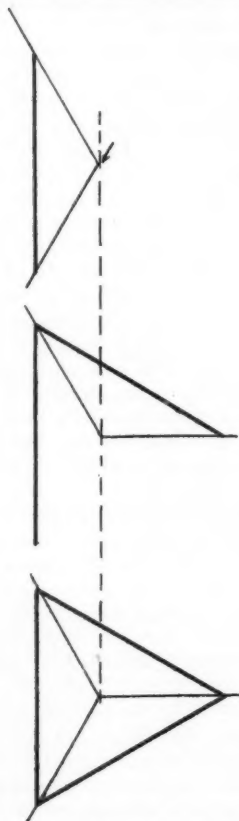
This is the continuation of a series of articles which will be contributed by Mr. Hart upon this rather difficult department of mineralogy. Mr. Hart's intention is to present this subject in untechnical language which will enable the reader to obtain practical information regarding the Systems of Crystallography, that he could obtain by independent and unguided study outside of the classroom.—THE EDITOR.

A FEW NOTES ABOUT SYMMETRY

Symmetry is the basis of crystallographic science, since crystal forms are made by symmetrical growth according to natural laws. Therefore, a close knowledge of symmetry is essential to proper use of crystallographic data, and a keen perception of symmetrical relations of distorted forms is necessary for the determination of crystals.

One type of symmetry is that of the usual layman's idea. A printed figure is symmetrical about a line, which is called the axis, when each point of the left of the axis has an exactly corresponding point on the right. Extending this definition to solid bodies, the axis becomes a plane and either side of the plane is exactly duplicated by the opposite side. No further regularity is implied by such a plane of symmetry, which may be well shown by the vertical plane through the longitudinal centerline of a ship. Every point on the outside has a corresponding point at the same distance from the plane on the other side, whether it be on the hull, rigging, or deck-houses. Yet the upper and lower parts of the ship are very different, and fore and aft are not at all alike.

More than one plane of symmetry may be present in a solid body; as in a canoe which has the longitudinal plane mentioned above and a second plane amidships at right angles to the first with the same relation as before. A cube has nine such planes of symmetry, as you can readily figure out. Planes of symmetry show a type often called MIRROR SYMMETRY because it is this type which is displayed by a mirror image as related to the object.



ILLUSTRATING 3-FOLD SYMMETRY

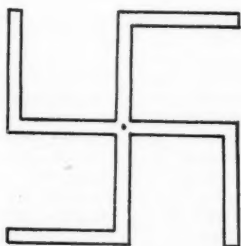
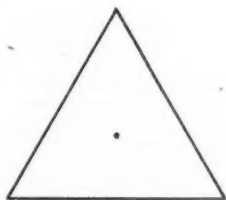
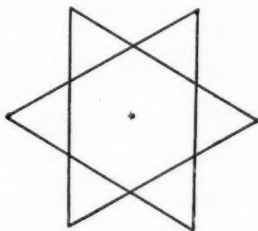
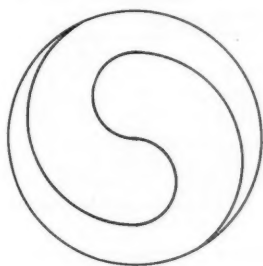
Another symmetrical figure is illustrated in the star or the equilateral triangle. If we consider one sector of the triangle, made by drawing lines through the center and two points, as shown in the sketch, and let this sector revolve one-third of a circle with the center as the point of rotation, the sector then falls exactly on the second side. Another one-third revolution makes the sector coincide with the third side; and a third movement of equal amount brings it back to its original position. The center is called a point of ternary or three-fold symmetry; since a three-fold rotation of one-third of the figure generates the complete figure. If the plane figure were a solid body, as a triangular prism or pyramid, our point of rotation would be crystallographically termed a ternary or three-fold axis of symmetry.

Similarly, a figure can have a point of binary symmetry; in which one-half of the figure is revolved one-half a revolution to correspond exactly with the other half. The Swastick is an example of this symmetry; and is even

further symmetrical, since a quarter turn will duplicate a quarter of the figure. So we see that a four-fold axis is always a two-fold axis; and will remember that the symmetry is named according to the highest symmetry in every case.

Solid bodies can have many different types of such axes of symmetry; but crystals are found to have only four types. The two-fold axis is common in many crystals; three-fold axes are shown in the diagonals of the cube and in many hexagonal minerals. Four-fold symmetry is typical of the octahedron and many other forms. Six-fold symmetry is more unusual, and is the basical symmetry for most hexagonal crystals. These four types of axial symmetry are the simplest, and no others have been observed on the vast number of natural and artificial crystals studied.

Many symmetrical bodies have a center of symmetry; that is, each point has an exactly corresponding point at the same distance beyond the center on a line drawn from the first point through the center. The boats do not have such a



FORMS HAVING BINARY SYMMETRY

center, but a cube does and so does a rectangular prism with flat ends. The presence or absence of such a center of symmetry is often characteristic of a mineral species; as the tetrahedrite crystal, having angles of an octahedron, is devoid of a center of symmetry and shown to be of a different class.

These three concepts of symmetry include the whole range of crystallographic ideas. Different combinations of planes, axes, and a center give the various classes into which all known crystals can be divided. One class has only a center of symmetry, while another is composed of nine planes of symmetry, four axes of three-fold symmetry, six axes of two-fold symmetry, three axes of four-fold symmetry, etc. It will be good practice to examine every crystal you meet for different types of symmetry,

comparing each face with others to discover just how many different types it may possess.

In studying symmetry of natural crystals one should always bear in mind the fact of unnatural development due to cramped positions, unequal flow of the depositing solutions, etc. These factors often cause unequal development of faces, and make theoretically equal lengths of great difference. Such is noteworthy in the hair-like growth of chalcotrichite, where cubes of cuprite are greatly elongated to fibrous forms through extensive development along one axis. The angles, however, always remain of the correct value, so that the student must observe angles very closely in connection with the faces to determine the true crystal relations.

MICRO-CHEMICAL STUDY OF THE METALLIC ORES AND MINERALS

By DR. H. C. DAKE
793½ Thurman St., Portland Oregon

This is the continuation of an intensely interesting series of articles on a new method of identifying minerals, in which the minerals are polished and etched with acids. While the idea is not original, nevertheless Dr. Dake will present a number of new features, and his methods are so simple that the amateur collector can easily follow them.—THE EDITOR.

PART 2

As a preliminary before attempting to make determinations with unknown minerals, it is advisable for the beginner to first obtain a series of known specimens of the more common metallic minerals. The following are suggested:

Argentite	Limonite
Arsenopyrite	Magnetite
Bornite	Malachite
Chalcocite	Marcasite
Chalcopyrite	Native Silver
Cinnabar	Niccolite
Cobaltite	Pyrite
Cuprite	Pyrrhotite
Franklinite	Rutile
Galena	Smaltite
Gold	Sphalerite
Hematite	Stibnite

Secure the above in the pure state if possible, or in a known mixture. Mount and preserve all known specimens for future reference and comparison with unknowns.

Under the binoculars first note the physical appearance of the minerals, as color, crystal outline if any and the degree of relief. Much can often be learned in mineral determination by physical appearance alone. For example, the color of native gold and chalcopyrite are quite similar on the polished surface, yet the experienced eye can readily distinguish between them. Color alone, however, is usually not an accurate guide as the color of many minerals is quite similar, and may even vary slightly in the same species from different localities.

Some minerals that are semi-opaque have a colored internal reflection, which is of diagnostic aid—cuprite and pyrrargyrite, for examples, show a bright red internal reflection.

Now observe crystal outline, if any. Pyrite, for example, will often exhibit the characteristic cubical outline, especially when present in minute crystals. Even when altered or leached out the cubical outline usually remains. The appearance of the surface itself is important, as the minerals of a high hardness, like quartz and pyrite, will stand out in bold relief while the softer minerals will have the appearance of being countersunk.

Next test for hardness with a small sharp needle mounted at an acute angle on a small wooden handle. The hardness test can be made on the polished surface, while under the magnifier, with far greater accuracy than in the ordinary way. With experience one can learn to determine hardness with a reasonable degree of accuracy. It should be noted that a highly polished surface will scratch somewhat more readily than a surface which is microscopically rough, although the difference is not great. The color of the powder (if any) from the needle scratch can also be readily noted. Many of the non-metallic minerals can be determined on the polished surface by their physical appearance, crystal outline, color, and hardness.

After the physical tests and observa-

tions have been made the reagents can be applied as outlined in the text. The reagents will be found to give definite and characteristic reactions with most species, while in some the reactions are more or less variable and hence not reliable. In some species of the same mineral but from a different locality a slight variation in the reactions will be noted. With this in mind it is obvious that determinations can only be made correctly by a careful observation of all the details.

After a number of reagents have been used on a surface the same can be renewed by the use of the rouge or whiting buff. In using whiting, it is well to remember that this material is alkaline and if not entirely washed from the specimen it may cause some confusion when the acid reagents are used. Powdered magnesia oxide is also an excellent final polishing agent and can be used by mixing with water into a thin paste.

Sands can be examined microchemically by imbedding in a matrix then ground and polished in the usual way. As a matrix, sealing wax can be used but this material does not hold the small grains of sand as satisfactory as the "zinc" and "silicate" cements used in dentistry. The "silicate" cement is white in color, sets quite hard in a few minutes, and the sand to be examined can be incorporated into the cement while making the mix.

U. S. CIVIL SERVICE OPPORTUNITIES

For those who are interested we are pleased to announce the following open competitive examination to be held in the near future by the U. S. Civil Service Commission:

Junior Metallurgist, \$2,000 a Year.

Applications for the above examination must be on file with the Civil Service Commission at Washington, D. C., not later than September 25th, 1928.

The examination is to fill vacancies

occurring in the Federal classified service throughout the United States.

The entrance salary is \$2,000 a year. Higher salaried positions are filled through promotions.

Full information may be obtained from the U. S. Civil Service Commission, Washington, D. C., or from the Secretary of the U. S. Civil Service Board of Examiners at the post office or customs house in any city.

PUBLICATIONS RECENTLY RECEIVED

Mineral Resources of the United States for 1925—Part 1, Metals—768 pages—4 illustrations; \$1.25 per copy. Part II, Non-metals—614 pages—\$1 per copy. Obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The total value of mineral products of the United States in 1925 was \$5,677,630,000, compared with \$5,305,800,000 in 1924, an increase of 7 per cent. The total value of metallic products in 1925 was \$1,380,280,000, an increase of 12 per cent over \$1,232,330,000 in 1924. Non-metallic mineral products, other than fuels, produced in 1925, were valued at \$1,232,420,000, an increase of 5 per cent over \$1,169,100,000 in 1924. The output of mineral fuels, coal, petroleum, natural gas, and natural-gas gasoline, in 1925 had an aggregate value of \$3,058,680,000, or 6 per cent more than the value, \$2,898,630,000 in 1924.

Economic Geology of the Castlegate, Wellington, and Sunnyside Quadrangles, Carbon Co., Utah: By Frank R. Clark—165 pages—23 illustrations—was recently issued by the U. S. Geological Survey, Washington, D. C., as Bull. 793.

The sections covered contain many important coal deposits and it was to obtain more detailed information regarding the geology of the fields that this report was made.

Annual Report of the Minister of Mines for the year ended December 31, 1927: Being an account of mining operations for gold, coal, etc., in the Province of British Columbia—505 pages—41 plans—65 photographs. Issued by the Minister of Mines, Victoria, B. C., Canada.

The year 1927 was again a prosperous and satisfactory one for the mineral industry of British Columbia. The gross value of the mineral production was \$60,729,358, as compared with \$67,188,842 in 1926, a decrease of \$6,459,484, or 9.6 per cent.

While the value of production was less than in 1926, this decrease is accounted for by the lowered metal prices rather than to decreased output of minerals. That the actual production in the aggregate did not decrease is shown by the fact that the 1927 output, if valued at 1926 prices, would give a production of approximately \$1,000,000 greater than in 1926. Furthermore, the tonnage of ore mined amounted to 5,416,021 tons, an increase of 640,948 tons over the 1926 output—the previous record year.

Thirty-Sixth Annual Report of the Ontario Department of Mines, Toronto, Canada, was recently issued as Vol. XXXVI, Part 1, 1927—199 pages—1 illustration.

The total value of the mineral output for the Province of Ontario in 1926 was \$85,098,706, being a decrease of \$2,484,600 or 2.8 per cent from the total of \$87,583,306 in 1925. While the production showed a small decline, there was great activity and keen interest displayed throughout the period and the momentary pause may be explained partly to the greatly decreased price of silver, which accounted for more than a million dollars of the decrease, and also to a drop in the value of cobalt and the output of nickel.

We are in receipt of Vol. 1, No. 1, of "The Junior Mineralogist," a mimeograph journal of a mineralogical society of high school boys in Philadelphia. The journal is most interesting. They boost ROCKS AND MINERALS and editorially express a desire to make it their club magazine. Their little journal of 3 long pages is full of interesting material and we are very glad to welcome it to our editorial desk. We wish our young friends success in their efforts to maintain a worth-while organization. Their enthusiasm is unbounded and we are very sure that from their ranks the expert mineralogists of the country will be recruited. We are expecting great things from this society.

WITH OUR CONTRIBUTORS

Dr. Eles, Chemist of The de Clair Laboratories, Los Angeles, Calif., has very kindly given us a description of the dolomitic limestone for which a handsome reward is offered to anyone who can give merely the location of the mineral which offers the desired electrical reaction. We hope some member of the Rocks and Minerals Association may be able to receive this reward. Should any member of the Association be so fortunate we hope he will write us and give full information as to the location and the discovery of this apparently very useful and very precious mineral.

We feel that we are very fortunate in obtaining this interesting article and we hope that Dr. Eles may find time to write us another article on this rare and very valuable mineral.

Dr. R. F. H. Harter of Montana, an expert Geologist-Geophysicist, is the contributor of the article on the Butte district of Montana. The manuscript was read with much interest by the Editor of ROCKS AND MINERALS and we are sure that our subscribers will enjoy an equal interest in reading the article in print.

Dr. Harter is one of our esteemed and enthusiastic friends and he has shown his interest in ROCKS AND MINERALS by sending us this most excellent article describing mineralogically the world-famous mining district of Butte, Mont., and in the next issue of the magazine we shall have another interesting article of his—"The Romance of Rocks and Minerals," which we are sure will be welcomed by our readers.

We trust that Dr. Harter will contribute further articles upon the mineral deposits of Montana with which he seems to be so familiar.

Mr. W. E. Mumford, a Metallurgist of Branford, Conn., is another new contributor whom we wish to introduce to

readers of ROCKS AND MINERALS. He has given us an excellent article: "A Convenient Arrangement of Mineral Specimens," which we are sure will be read with considerable interest, especially by those collectors who are confronted with the difficulty of properly and conveniently housing and displaying their mineral specimens. It would be a great pleasure to look over Mr. Mumford's collection and note the system of arrangement as worked out by him. Another attraction that would appeal to most of us is his Connecticut cabinet which contains a very good representation of his State's contribution to mineralogy.

We trust Mr. Mumford can favor us with another contribution in the near future.

We have very much pleasure in printing in this issue the Commencement essay of Miss Eleanore V. Prokes of Jackson, Minn., on "The Story We Read in the Rocks." Miss Prokes is a daughter of one of our esteemed and valued subscribers and we are glad to welcome her into the ranks of interested mineralogists. Her essay shows her enthusiasm and we trust that at some future day when her experience has been broadened in the collecting field to have some informative articles from her pen.

Another new contributor is Edward Gilden of the Boy Scout Mineral club, Stamford, Conn. Mr. Gilden is a young mineralogist who finds great pleasure and enjoyment in collecting minerals.

We wish to congratulate the Boy Scouts of Stamford, Conn., for having members in its organization sufficiently interested in minerals as to form a mineral club of their own. This is an example for other scouts to follow as we believe that every Boy Scout troop should manifest some interest in minerals.

EDITORIAL

It will be a matter of great regret to our readers, as it has been to the Editor, to know that the fascinating department, "The Beginner's Cabinet," conducted by Mrs. Ilsen Nathalie Gaylord, is omitted from this issue because of Mrs. Gaylord's illness. The readers of ROCKS AND MINERALS, we feel assured, will join with us in expressions of sympathy to Mrs. Gaylord and in our most sincere wish that she will soon be restored to health.

M. Mawby of Broken Hill, N. S. W., Australia, has written to the Editor of ROCKS AND MINERALS stating that for the past four months he has been absent from home inspecting various mines and mine localities. During this period, he has been informed, his mail has been accumulating and that he is in receipt of a number of mail parcels. He wishes, through the pages of this magazine, to assure the writers and senders of packages that immediately upon his return home it will be his first privilege and pleasure to answer and acknowledge the store of mail awaiting him.

We should like to call our readers attention to the advertising pages of ROCKS AND MINERALS. We have from time to time, received numerous letters asking where certain work can be done or specimens obtained which we probably would not have received if our readers had looked through the advertising section of the magazine. Whether you are in need of anything or not you will find it interesting to look through our advertising pages and become acquainted with the names of our advertisers.

Messrs. George W. Gordon and Daniel T. Robinson, members of the Westchester County Park Commission Engineering force, Peekskill, N. Y., have presented the Editor of ROCKS AND MINERALS with a photograph of Stark's Knob and some very interesting speci-

mens of diabasic lava from this unique locality. Stark's Knob, near Schuylerville, Saratoga County, is the only volcano (extinct) found in the State of New York.

Mr. Robinson also presented the Editor with some interesting glaciated slabs from the shores of Lake Champlain near Plattsburg, N. Y.

We wish to express our thanks and appreciation to these young Civil Engineers for their thoughtfulness of ROCKS AND MINERALS and its Editor.

Owing to stress of work which prevented the completion of some important experiments necessary in preparing the copy for "The Phosphorescence of Minerals" which was to have appeared in this issue of ROCKS AND MINERALS the manuscript was not received in time to be included in this number. It will appear in the December issue.

C. A. Hartnagel, Assistant Geologist of the State of New York, and a warm friend of ROCKS AND MINERALS, has contributed to this issue a most interesting article descriptive of geologic features of Stark's Knob, the only volcanic remains known to exist in the State of New York.

Mr. Hartnagel is in charge of the State Mineralogical Collection and its arrangement. While the collection is general in character, Mr. Hartnagel has gathered together specimens of practically all the important minerals found in the State of New York and the mineralogical section of the State Museum is one of the most interesting for the visitor whether he be unfamiliar with mineralogy or a student of that very interesting and important branch of knowledge. It will well repay any of the members of the Rocks and Minerals Association, who are passing through Albany, to stop over and see this interesting mineral display which is in the Education Building. The Editor is very sure that Mr. Hartnagel will welcome any member of the Rocks and Minerals Association who will call upon him when in Albany.

